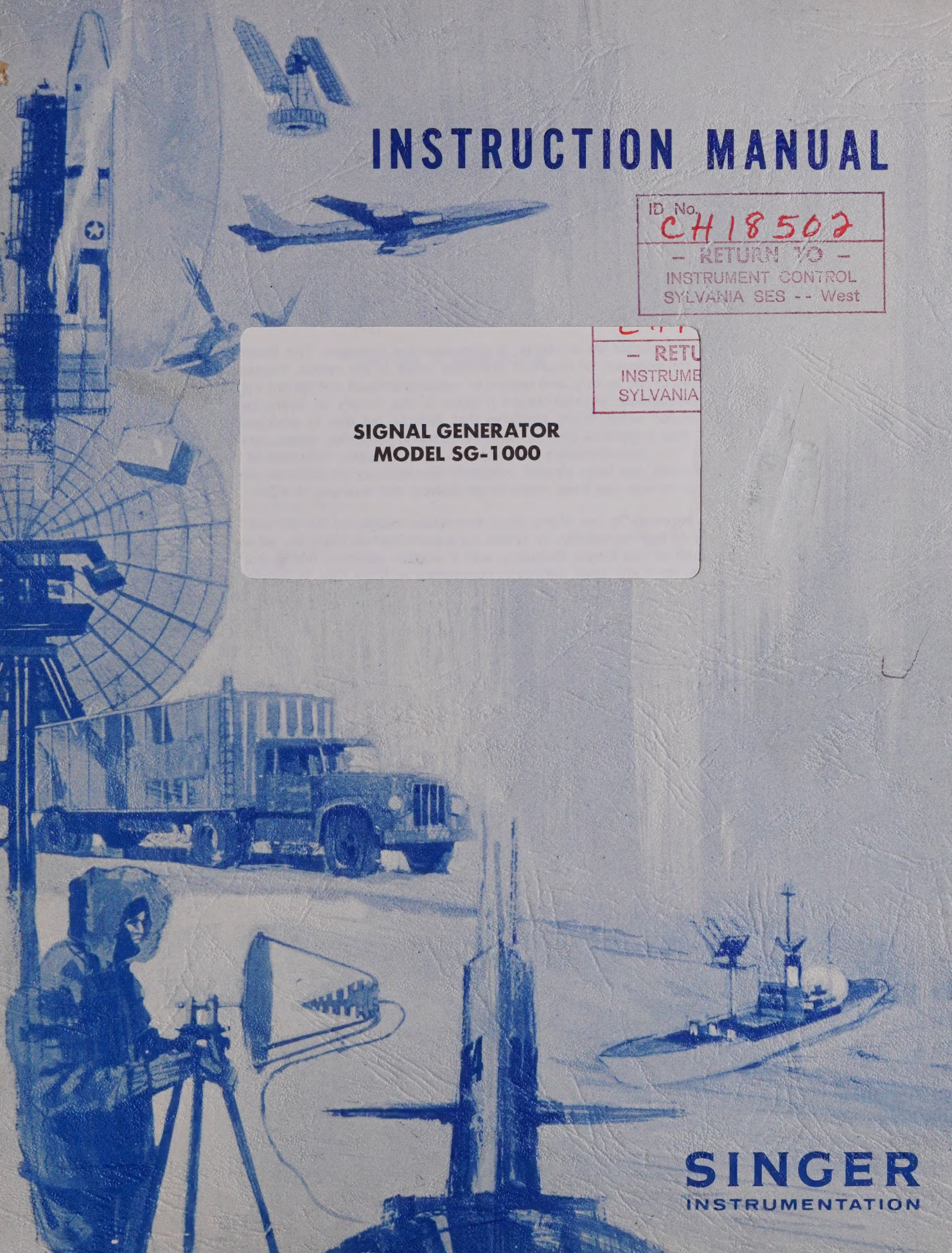
INSTRUCTION MANUAL

ID No. CH18507
– RETURN TO –
INSTRUMENT CONTROL
SYLVANIA SES -- West

– RETU
INSTRUME
SYLVANIA

SIGNAL GENERATOR
MODEL SG-1000



SINGER
INSTRUMENTATION

INSTRUCTION MANUAL

ID No. CH18502
– RETURN TO –
INSTRUMENT CONTROL
SYLVANIA SES -- West

SIGNAL GENERATOR
MODEL SG-1000

PRELIMINARY

Serial No. 11-5000 2

Instruction Manual No. 110-5093

SINGER
INSTRUMENTATION
THE SINGER COMPANY • INSTRUMENTATION DIVISION
Creative Products for Test, Measurement, Analysis, Calibration

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Other Electrical and Electronic Measuring Instruments . . . 1 year*

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SINGER
INSTRUMENTATION

The Singer Company, Instrumentation Division, Home Office: 915 Pembroke Street, Bridgeport, Conn. 06608
Telephone: (203) 366-3201 Twx: 710-453-3483

REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Bridgeport Operation, 915 Pembroke Street, Bridgeport, Connecticut, 06608 for Empire, Panoramic and Sensitive Research instruments.
Contact Gertsch Operation, 3211 S. LaCienega Blvd., Los Angeles, California, 90016 for Gertsch instruments
Contact EMC Operation, 3211 S. LaCienega Blvd., Los Angeles, California, 90016 for EMC Instruments
Contact Ballantine Operation, P.O. Box 97, Boonton, New Jersey, 07005 for Ballantine instruments

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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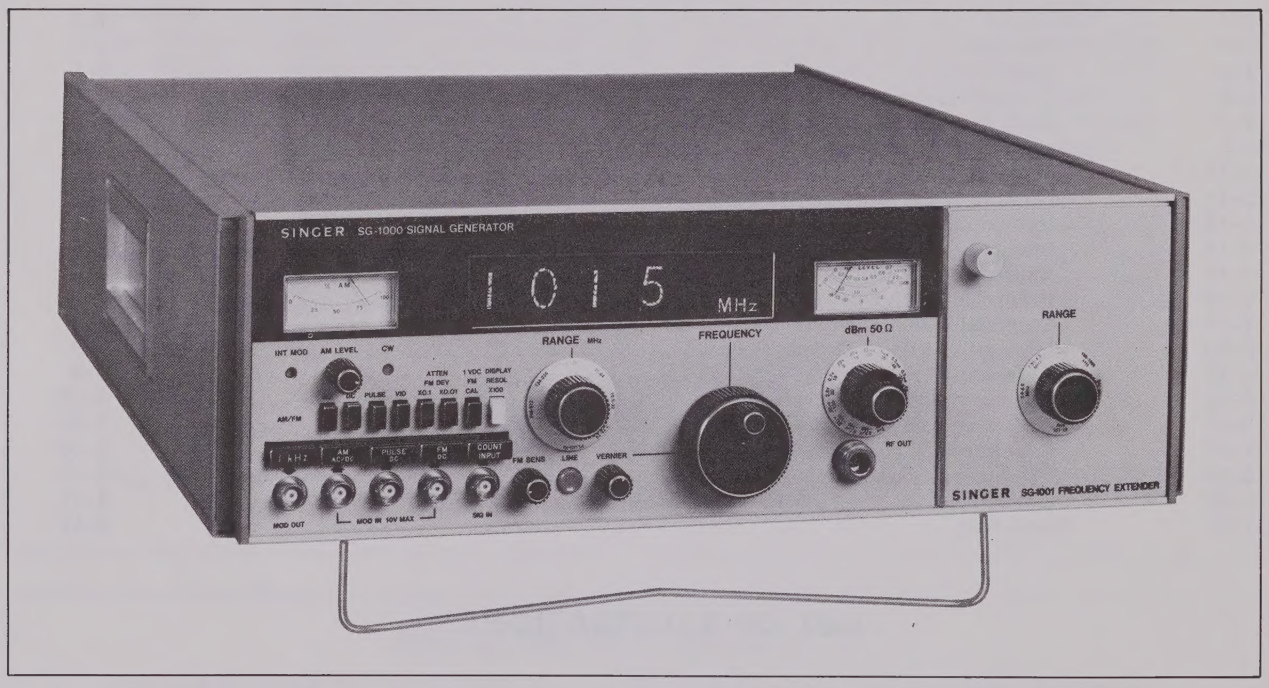


Figure 1-1. Model SG-1000 Signal Generator with Model SG-1001 Frequency Extender Plug-In Module Installed

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual provides operating instructions for both the Model SG-1000 Signal Generator and its optionally available accessory, the Model SG-1001 Frequency Extender plug-in module (see figure 1-1), manufactured by The Singer Company - Instrumentation Division. This manual also includes the general information, theory of operation, maintenance information, schematic diagrams and parts list for the Model SG-1000 Signal Generator.

Note

The general information, theory of operation, maintenance, schematic diagrams and parts list for the Model SG-1001 Frequency Extender module (when ordered) forms a supplement to this manual.

If the Model SG-1001 Frequency Extender module is not furnished with the equipment, disregard all manual references to the module.

1-3. The information contained in this handbook refers to the standard Models SG-1000 Signal Generator and SG-1001 Frequency Extender. Differences in equipment configuration, components, specifications or performance resulting from customer application requirements and/or The Singer Company's continuous product improvement program are described in addendum sheets.

1-4. GENERAL DESCRIPTION.

1-5. The Models SG-1000 Signal Generator and SG-1001 Frequency Extender module (hereafter referred to collectively as the Signal Generator) form a compact, highly sophisticated, state-of-the-art laboratory instrument that covers the frequency range from 61 kHz to 512 MHz in thirteen overlapping bands. Its design is based on a unique, stable and spectrally-pure solid-state tunable UHF master oscillator whose output frequency is divided, as required, to obtain the desired frequency.

1-6. The output frequency is coupled to a three digit frequency counter having a one digit overrange and a X100 expansion capability, thereby permitting direct frequency readout of up to six digits. This feature provides unparalleled resettability and frequency accuracy..... typically between 0. 001 and 0. 08%, depending on the output frequency. In addition, the counter may be used to measure the frequency of external signals within the range from 100 Hz to 2 MHz.

1-7. The output level of the Signal Generator is maintained flat within ±0. 25 dB up to 125 MHz and within ±0. 5 dB over its full frequency range, independent of band switching. Its modulation capabilities include AM, FM, video and pulse, with negligible interaction when using two modes concurrently (i. e., AM/FM or FM/pulse). A 150 dB step attenuator and adjustable level control provide a total signal amplitude range of 166 dB, surpassing that of any other available signal generator.

1-8. The Signal Generator is compatible with automated test systems and computer control. Optionally available BCD inputs and outputs permit digital control of step attenuation and digital printout of the actual frequency to the full counter accuracy. Analog inputs permit continuous control of r-f level over a range of at least 16 dB and frequency adjustment over a 1% range.

1-9. In flexibility, frequency range and operating convenience, the Signal Generator cannot be matched by any two conventional instruments.

1-10. PURPOSE AND USE OF THE EQUIPMENT.

1-11. The flexibility, frequency range and ease of operation makes the Signal Generator ideal for both laboratory and production line use. Typical applications include the following.

a. Evaluating modulation techniques and receiver performance with AM, FM, pulse, video, AM/FM, FM/pulse or FM/video signals.

b. Aligning and testing of AM, FM and radar receivers.

c. High-level testing of amplifiers, mixers, multipliers, etc.

d. Testing sensitive narrowband receivers.

e. Accurate, stable measurement of attenuators.

f. Measuring dynamic AM rejection in AM/FM systems.

g. Doppler-shift moving target signal simulation.

h. Ratio detector/discriminator alignment.

i. Measuring limiter time constant.

j. Narrowband component analysis.

k. Multipole filter response characteristics.

l. Determining receiver signal-to-noise ratio.

1-12. EQUIPMENT SUPPLIED

1-13. The Signal Generator is shipped complete and is ready for use upon receipt. The complete Signal Generator consists of the following items.

a. One (1) Model SG-1000 Signal Generator.

b. One (1) Model SG-1001 Frequency Extender module (installed in item a).

c. One (1) line cord (Singer Part No. 179-7004-001).

d. One (1) Model SG-1024 Frequency Doubler (supplied only when specifically ordered).

1-14. If only a Model SG-1000 Signal Generator is ordered, the shipment will contain items a and c of paragraph 1-13. A cover panel (Singer Part No. 103-1982-001) will be mounted on the equipment front panel to cover the well normally occupied by the Model SG-1001 Frequency Extender module.

1-15. SPECIFICATIONS.

1-16. The electrical and physical characteristics of the Signal Generator are listed in table 1-1.

TABLE 1-1. SPECIFICATIONS

<table>
<tr><th>Parameter</th><th>Specification</th></tr>
<tr><td colspan="2">SIGNAL GENERATOR OPERATION</td></tr>
<tr><td>Frequency Range, Resolution, Resettability and Accuracy (resettability = accuracy)</td><td>
<table>
<tr><th>Tuning Band</th><th>Frequency Range</th><th>Resolution</th><th>Accuracy[1,4]</th></tr>
<tr><td>1</td><td>248-512 MHz</td><td>10 kHz</td><td>0.004%</td></tr>
<tr><td>2</td><td>124-256 MHz</td><td>10 kHz</td><td>0.008%</td></tr>
<tr><td>3</td><td>62-126 MHz</td><td>1 kHz</td><td>0.0016%</td></tr>
<tr><td>4</td><td>31-64 MHz</td><td>1 kHz</td><td>0.0032%</td></tr>
<tr><td>5</td><td>15.5-32 MHz</td><td>1 kHz</td><td>0.0064%</td></tr>
<tr><td>6</td><td>7.75-16 MHz</td><td>100 Hz</td><td>0.0013%</td></tr>
</table>
</td></tr>
<tr><td>Electronic (vernier) tuning range</td><td>Greater than 300 ppm</td></tr>
<tr><td>Frequency Stability:</td><td></td></tr>
<tr><td>Residual FM</td><td>Less than 0.25 ppm peak</td></tr>
<tr><td>Drift</td><td>Typically 10 ppm/10 minutes after a 1 hour warmup</td></tr>
<tr><td>Temp. coefficient</td><td>Typically less than 50 ppm/1°C</td></tr>
<tr><td>Line voltage</td><td>Change less than 10 ppm/±10% change in line voltage</td></tr>
<tr><td>Band switching</td><td>Negligible frequency drift caused by band switching</td></tr>
<tr><td>Load variation</td><td>No discernible frequency change from short to open circuit</td></tr>
<tr><td>Spurious Outputs:</td><td></td></tr>
<tr><td>Harmonics</td><td>Greater than 30 dB below carrier</td></tr>
<tr><td>Subharmonics</td><td>Greater than 50 dB below carrier</td></tr>
<tr><td>Broadband noise</td><td>Typically greater than 80 dB below carrier in a 1 kHz bandwidth up to 62 MHz; 90 dB below carrier in a 1 kHz bandwidth up to 512 MHz.</td></tr>
<tr><td>RF Output:</td><td></td></tr>
<tr><td>Range —</td><td></td></tr>
<tr><td>CW, FM, Pulse and Video</td><td>+20 to -146 dBm (2.2V to 0.011μV)</td></tr>
<tr><td>AM</td><td>+14 to - 146 dBm (1.1V to 0.011μV)</td></tr>
<tr><td>Level —</td><td></td></tr>
<tr><td>Indication</td><td>Sum of meter reading and step attenuator setting</td></tr>
<tr><td>Variation with frequency</td><td>RF output constant ±0.25 dB to 125 MHz, ±0.5 dB 125 to 512 MHz</td></tr>
<tr><td>Variation with line voltage</td><td>Less than ±0.05 dB/±10% change in line voltage</td></tr>
</table>

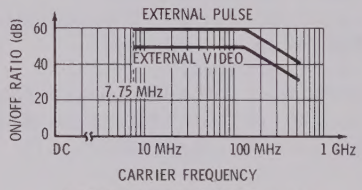
(Cont'd)

TABLE 1-1. SPECIFICATIONS (Cont'd)

Parameter	Specification
SIGNAL GENERATOR OPERATION (Cont'd)	
RF Output (Cont'd):	
Meter	
Ranges	0 to -16 dB, 2.2 to 0.5V and 0.7 to 0.1V
Linearity	±2% of full scale
Attenuation —	
Range	0 to 150 dB in 10 dB steps
Accuracy	Better than ±0.15 dB/10 dB; maximum cumulative error ±1.5 dB
Leakage	Permits measurements down to -146 dBm
Impedance	50 ohms
Connector	Type N, female
VSWR	Less than 1.5:1 when step attenuator is set for +10 dBm; less than 1.25:1 for all greater attenuator settings
Modulation:	Internal and external AM and FM, external pulse and external video
Internal AM —	
Frequency	1 kHz, adjustable ±20%
Range	0 to 100%, indicated on front panel meter
Accuracy	±5% of full scale
Distortion	Less than 2% @ 30% AM; less than 5% @ 70% AM
Incidental FM	Less than 1.0 ppm peak @ 30% AM
Internal FM —	
Frequency	1 kHz, adjustable ±20%
Deviation voltage	1 volt peak (±1%). This provides the peak deviation calibrated by FM deviation calibrator
Deviation	±0.2% minimum
Deviation calibration	Internal -1 volt reference (in conjunction with FM SENS control and digital readout) permits calibration of peak deviation
Calibrated deviation attenuation	X0.1 and X0.01, accuracy ±1%
Auxiliary 1 kHz output —	
Level	1.0 volts, peak-to-peak, nominal
Impedance	1000 ohms, nominal
Connector	Type BNC, female
External AM —	
Frequency	
DC coupled	DC to greater than 200 kHz; response flat within ±1 dB @ 30% AM
AC coupled	20 Hz to greater than 200 kHz; response flat within ±1 dB @ 30% AM (Curve below shows usable % AM as a function of modulating frequency)
Range	0 to 100% indicated on front panel meter
Accuracy	±5% of full scale
Typical AM performance	TYPICAL MAXIMUM USABLE % AM AS A FUNCTION OF MODULATING FREQUENCY
Distortion	Less than 2% @ 30% AM; less than 5% @ 70% AM (1 kHz)
Incidental FM	Less than 1.0 ppm peak @ 30% AM
Input level	Less than 2 volts RMS required for 100% AM
Input impedance	600 ohms, nominal
Input connector	Type BNC, female

(Cont'd)

TABLE 1-1. SPECIFICATIONS (Cont'd)

Parameter	Specification
SIGNAL GENERATOR OPERATION (Cont'd)	
Modulation (Cont'd):	
External FM —	
Modulating frequency	DC to greater than 200 kHz
Frequency response	±1 dB, DC to 200 kHz
Deviation	±0.5%, minimum
Distortion	Less than 0.5% @ ±0.1% deviation
Input level	±2.7 volts (nominal) for maximum deviation; positive input voltage increases frequency
Deviation calibration	Internal -1.00 volt reference (in conjunction with FM SENS control and digital readout) permits calibration of peak deviation
Calibrated deviation attenuator	X0.1 and X0.01, accuracy ±1%
Incidental AM	Greater than 50 dB below carrier level @ 0.01% peak deviation
Incidental FM	Less than 0.5 ppm peak
Input impedance	5000 ohms, nominal
Input connector	Type BNC, female
External Pulse —	
Rise and fall times	Down to 20 nsec[2]
Repetition rage	DC to 500 kHz[2]
Minimum pulse width	4 μsec pulse produces less than 1 dB error in RF LEVEL meter indication
On/off ratio with RF LEVEL meter set for full scale (ratio of output level during pulse to level in absence of pulse)	 TYPICAL MINIMUM ON/OFF RATIO AS A FUNCTION OF CARRIER FREQUENCY
Input level	Pulses exceeding threshold level of +1.0 volt produce leveled output pulses of amplitude indicated by RF LEVEL meter
Input pulse rise and fall time	Less than 5 μsec for leveled operation
Input impedance	50 ohms, nominal
Input connector	Type BNC, female
External Video —	
Rise and fall times	Down to 20 nsec[2], typical
Pulse repetition rate	20 Hz to 500 kHz
Video frequency range	DC to 100 MHz
Minimum pulse width	4 usec pulse produces less than 1 dB error in RF LEVEL meter indication
Linearity	RF output linearly follows video input until limiting
On/off ratio with RF LEVEL meter set for full scale (ratio of limited output level to output level in absence of signal)	See curve above
Input level	Minimum video input amplitude of +1 volt required for activation of leveling circuitry
Input impedance	50 ohms, nominal
Input connector	Type BNC, female
Simultaneous modulation	Concurrent AM/FM, FM/Pulse or FM/Video

(Cont'd)

TABLE 1-1. SPECIFICATIONS (Cont'd)

Parameter	Specification
COUNTER OPERATION	
Frequency range	100 Hz to 2 MHz[2]
Count accuracy	±1 count ± time base accuracy
Time base accuracy	Typically better than 1 ppm after warmup @ 25°C
Time base stability	Typically better than 0.1 ppm/°C
Count resolution	±10 Hz
Input waveform	Pulse, sinusoid or trapezoid
Minimum pulse width	100 nsec
Sensitivity	300 mV peak-to-peak
Input impedance	10,000 ohms, nominal
Input connector	Type BNC, female
GENERAL	
Operating power requirements	115 or 230 volts (±10%), 47 to 420 Hz, single-phase
Power consumption	60 watts
Weight	53 pounds
Dimensions	5-1/4" H x 16-3/4" W[3] x 22" D
RFI	Meets MIL-I-6181D

Notes:
1. Worst case condition. . . ±1 count at low end of band.
2. Depending on output frequency.
3. Adapters available for mounting in a 19 inch rack.
4. Plus time base accuracy.

SECTION II
OPERATION

2-1. GENERAL.

2-2. This section contains instructions for the installation and operation of the Signal Generator. It is strongly recommended that the operator become thoroughly familiar with the material in this section before attempting to operate the equipment. Failure to do so may compromise the great versatility and exceptional capabilities engineered into the equipment.

2-3. INSTALLATION.

2-4. The Signal Generator is shipped complete and is ready for use upon receipt. The Model SG-1001 Frequency Extender module, when ordered as part of the equipment, is shipped installed in the unit. After the equipment has been unpacked, check the contents of all shipping containers against the packing invoice to ascertain that the order is complete.

2-5. INSPECTION. Examine the equipment for indications of damage which may have occurred during shipment. Check all front panel controls for freedom of movement, full travel and positive detent locking. Note any evidence indicating that the equipment has sustained a severe mechanical shock. Check the condition of all accessories furnished as part of the order.

2-6. BENCH MOUNTING. The Signal Generator should be placed on a sturdy, vibration-free surface. The front panel of the equipment can be elevated slightly for easier access to controls and connectors by lowering the tilt stand located underneath the cabinet. Apply power as directed in paragraph 2-8.

2-7. RACK MOUNTING. To install the Signal Generator (see figure 2-1) in a standard 19-inch rack, proceed as directed below.

WARNING

BEFORE INSTALLING THE SIGNAL GENERATOR INTO THE RACK, PERFORM STEPS A AND B OF PARAGRAPH 2-9.

a. Remove both decorative side panel plates from the Signal Generator by unscrewing the two 6-32 screws that secure each panel to the equipment frame.

b. Secure both side plates (furnished as part of Rack Mounting Kit - Singer Part No. 102-0177-001) to the equipment frame using the 6-32 flat head screws supplied.

c. Secure the set of rack slides and spacer plates (furnished as part of the kit) to the side plates installed in step b using the 10-32 pan head screws and #10 lockwashers supplied.

d. Secure a handle to each rack mounting ear using the 10-32 flat head screws supplied.

e. Remove the filler strips from the front corner pieces of the instrument and secure the rack mounting ears (assembled in step d) to the corners using the 8-32 fillister head screws supplied.

f. Install the Signal Generator into the rack. Secure the mounting ears to the rack.

g. Perform steps d and e of paragraph 2-9.

2-8. POWER APPLICATION AND TURN-ON PROCEDURE.

2-9. The Signal Generator is designed to operate from either a 115 volt or 230 volt (±10%), 47 to 420 Hz power line. Power consumption is approximately 73 watts (60 watts without the Model SG-1001 Frequency Extender module). To couple the Signal Generator to line power, proceed as directed in the following steps.

CAUTION

THE SIGNAL GENERATOR IS NORMALLY SHIPPED WITH A LINE PROTECTIVE FUSE RATED AT 1 AMPERE (DELAY TYPE) INSTALLED AND THE REAR PANEL 115V/230V SLIDE SWITCH SET TO THE 115V POSITION. IF THE SIGNAL GENERATOR IS TO BE POWERED FROM A 230 VOLT LINE, INSTALL A DELAY TYPE FUSE RATED AT 1/2 AMPERE @ 230V IN PLACE OF THE 1 AMPERE FUSE, SET THE 115V/230V SLIDE SWITCH TO 230V AND CONSPICUOUSLY MARK THE SIGNAL GENERATOR TO INDICATE IT HAS BEEN MODIFIED FOR 230-VOLT OPERATION.

NOTES:

1. ALL DIMENSIONS IN INCHES.
2. RACK MOUNTING BRACKETS SHOWN ARE OPTIONAL ACCESSORIES.
3. REMOVE FEET AND TILT BAR FROM BOTTOM COVER BEFORE RACK MOUNTING.
4. RACK MOUNTING SLIDES SHOWN DASHED. SIDE HANDLES DO NOT APPEAR WHEN MODIFIED FOR SLIDE RACK MOUNTING.

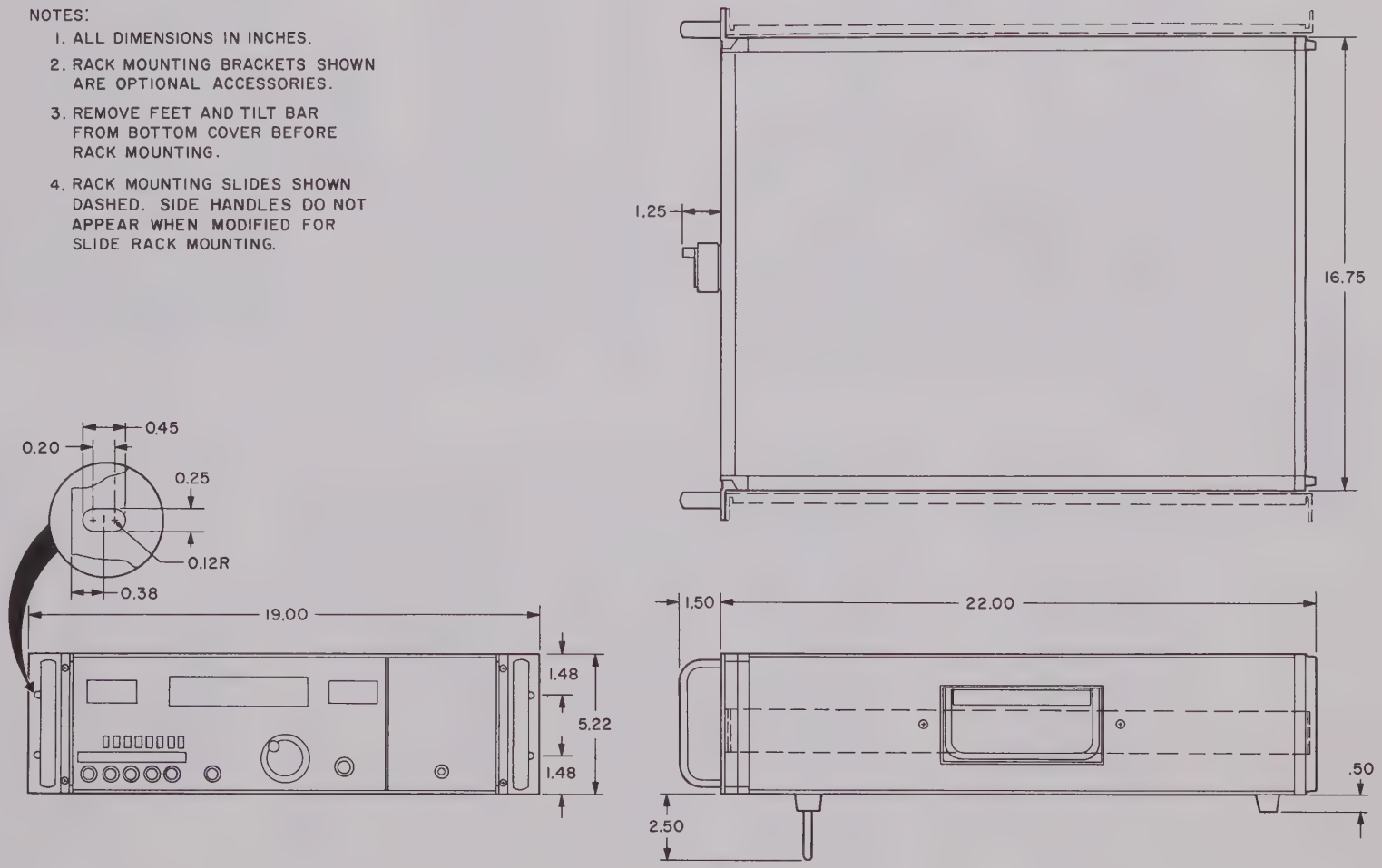


Figure 2-1. Installation Outline Drawing

a. Determine the voltage available at the power output receptacle. If the line voltage is 230 volts, set the rear panel 115V/230V slide switch to the 230V position and install a delay type fuse rated at 0.5 ampere @ 230V into the rear panel fuseholder.

b. Couple the female connector of the supplied power cord to the rear panel power input receptacle.

WARNING

THE SIGNAL GENERATOR IS DESIGNED FOR OPERATION FROM A POLARIZED THREE-TERMINAL (ONE GROUND) POWER RECEPTACLE.

IF A THREE-TERMINAL POWER RECEPTACLE IS NOT AVAILABLE, A THREE-PRONG TO TWO-PRONG ADAPTER SHOULD BE USED TO PREVENT A POTENTIAL SHOCK HAZARD. CONNECT THE PIGTAIL LEAD OF THE ADAPTER TO POWER RECEPTACLE GROUND.

c. Couple the polarized male connector at the other end of the supplied power cord to the line power receptacle.

d. Depress the red LINE pushbutton switch; the Signal Generator is now energized and the frequency counter indicator tubes will illuminate. For maximum stability, allow a warmup period of 30 minutes between application of power and actual use.

2-10. OPERATING CONTROLS, INDICATORS AND CONNECTORS.

2-11. All controls, indicators and connectors necessary for the operation of the Signal Generator are located on the front and rear panels, as illustrated in figure 2-2; their functions are described in table 2-1.

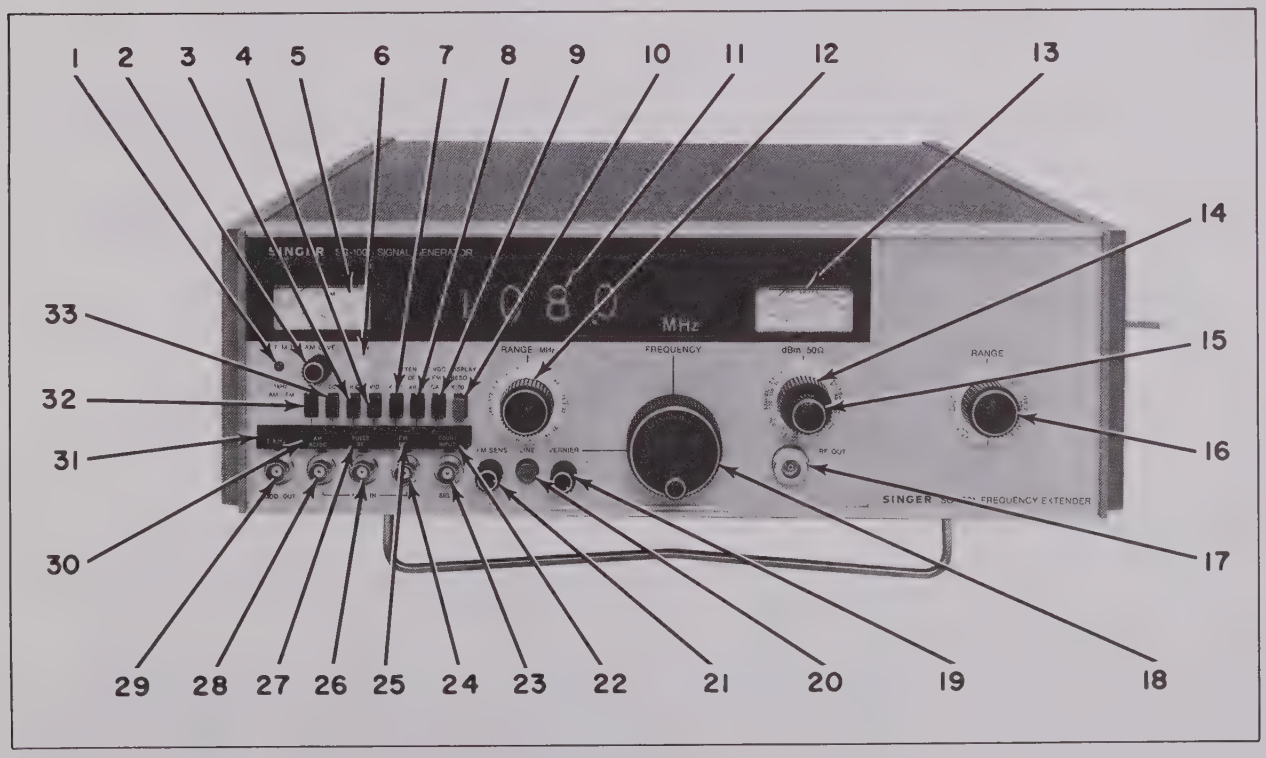


Figure 2-2. Operating Controls, Indicators and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

Control, Indicator or Connector	Figure 2-2 Index No.	Function
INT MOD AM/FM screwdriver control	1	Adjusts the frequency of the internal 1 kHz audio frequency oscillator between 800 and 1200 Hz. The exact frequency can be readily set by depressing the 1 kHz pushbutton switch (31), coupling the signal from the MOD OUT jack (29) to the SIG IN jack (23) and depressing the COUNT INPUT pushbutton switch (22).
AM LEVEL control	2	Adjusts the percentage modulation of the output signal when the Signal Generator is operated in either the internal or external AM mode.
PULSE pushbutton switch	3	When depressed concurrently with the PULSE DC pushbutton switch (27), permits modulation of the output signal by externally generated pulses coupled to the MOD IN PULSE DC jack (26).
VID(eo) pushbutton switch	4	When depressed concurrently with the PULSE DC pushbutton switch (27), permits linear wide-band video modulation by externally generated complex waveforms coupled to the MOD IN PULSE DC jack (26).
% AM meter	5	Indicates percentage modulation, from 0 to 100%, of the amplitude-modulated output.
CW indicator	6	Illuminates when all modulation selector push-button switches (AM AC/DC, PULSE DC and FM DC) are released, indicating that an unmodulated signal is available at the RF OUT jack (17).
ATTEN FM DEV X0.1 pushbutton switch	7	When depressed concurrently with the FM DC pushbutton switch (25), multiplies the deviation sensitivity established by a factor of 0.1.
ATTEN FM DEV X0.01 pushbutton switch	8	Same as ATTEN FM DEV X0.1 pushbutton switch (7) except factor is 0.01.
1 VDC FM CAL pushbutton switch	9	Momentary action switch which, when held depressed concurrently with the FM DC push-button switch (25), permits calibration of the deviation sensitivity by adjustment of the FM SENS control (21).
DISPLAY RESOL X100 pushbutton switch	10	Pushbutton switch which, when depressed, extends the resolution of the frequency counter (11) by two digits, thereby providing frequency resolution of five or six digits.
Frequency counter	11	Provides a digital readout (up to four significant figures) of the output frequency during generator operation or an applied signal during counter operation. Count resolution can be expanded by two digits by depressing the DISPLAY RESOL X100 pushbutton switch (10).

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index No.	Function
RANGE MHz switch	12	Selects the desired frequency octave band during generator operation. These bands are: 248 to 512 MHz 124 to 256 MHz 62 to 128 MHz 31 to 64 MHz 15.5 to 32 MHz 7.75 to 16 MHz PLUG-IN When set to the PLUG-IN position, the frequency octave band is determined by the setting of the Model SG-1001 Frequency Extender module RANGE switch (16).
RF LEVEL meter	13	Indicates the r-f output level, in both power and voltage, at the RF OUT jack when the Signal Generator is terminated by a 50 ohm load. The actual output level, in dBm, is equal to the algebraic sum of the meter dB scale reading and the dBm 50 Ω switch (14) attenuator factor; the output voltage is equal to the appropriate meter VOLTS scale reading and scale factor.
dBm 50 Ω switch	14	Inserts attenuation (0 to 150 dB in 10 dB steps) in signal path.
dBm 50 Ω control	15	Permits continuous adjustment of signal level coupled to output attenuator from +20* to +4 dBm, thereby providing continuous adjustment of Signal Generator output level from +20 to –146 dBm.
RANGE switch	16	Selects the desired frequency octave band of the Model SG-1001 Frequency Extender module when the Model SG-1000 Signal Generator RANGE MHz switch (12) is set to PLUG-IN. These bands are: 3.9 to 8.0 MHz 1.95 to 4.0 MHz .95 to 2.0 MHz 490 to 1000 kHz 244 to 500 kHz 122 to 250 kHz 61 to 125 kHz
RF OUT jack	17	Type N female connector at which the Signal Generator output is available.
FREQUENCY control	18	Main tuning control which provides continuous adjustment of the output frequency over any selected octave band.
VERNIER control	19	Provides fine adjustment of the output frequency.

*In AM operation, the maximum r-f output level is limited to +14 dBm.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index No.	Function
LINE pushbutton switch	20	Couples line power to the Signal Generator when depressed.
FM SENS(itivity) control	21	Permits calibration of the deviation sensitivity during FM operation using the internal 1 volt reference (1 VDC FM CAL pushbutton switch (9) depressed).
COUNT INPUT pushbutton switch	22	When depressed, couples the SIG IN jack (23) to the counter circuitry and converts the Signal Generator to a frequency counter without interrupting the r-f output.
SIG IN jack	23	Type BNC female connector through which external pulsed, sinusoidal or trapezoidal waveforms are coupled to the internal frequency counter when the COUNT INPUT pushbutton switch (22) is depressed.
MOD IN FM DC jack	24	Type BNC female connector through which modulating signals are d-c coupled during external FM operation.
FM DC pushbutton switch	25	When depressed, places the Signal Generator in the FM operating mode. Output signal is frequency modulated by the internal 1 kHz audio oscillator (when the 1 kHz pushbutton switch (31) is depressed) or by an external signal applied to the MOD IN FM DC jack (24).
MOD IN PULSE DC jack	26	Type BNC female connector through which external modulating signals are d-c coupled when the PULSE DC pushbutton switch (27) and PULSE (3) or VID (4) pushbutton switch are depressed.
PULSE DC pushbutton switch	27	When depressed, places the Signal Generator in the pulse or video modulation operating mode. Output signal is modulated by the externally generated signal applied to the MOD IN PULSE DC jack (27).
MOD IN AM AC/DC jack	28	Type BNC female connector through which external amplitude modulation signals are either a-c or d-c coupled when the AM AC/DC pushbutton switch (30) is depressed.
MOD OUT jack	29	Type BNC female connector through which the internally generated 1 kHz audio oscillator output (available only when the 1 kHz pushbutton switch (31) is depressed) is coupled to auxiliary test equipment.
AM AC/DC pushbutton switch	30	When depressed, places the Signal Generator in the AM operating mode. Output signal is amplitude modulated by the internal 1 kHz audio oscillator (when the 1 kHz pushbutton switch (31) is depressed) or by an externally generated signal applied to the MOD IN AM AC/DC jack (28).

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index No.	Function
1 kHz pushbutton switch	31	Energizes the internal 1 kHz audio oscillator when depressed, simultaneously open-circuiting the externally generated modulating signals applied to the MOD IN AM AC/DC and/or FM DC jack, thereby preventing external modulation.
AC pushbutton switch	32	When depressed concurrently with the AM AC/DC pushbutton switch (30), a-c couples externally generated modulating waveforms applied to the MOD IN AM AC/DC jack (28).
DC pushbutton switch	33	When depressed concurrently with the AM AC/DC pushbutton switch (30), d-c couples externally generated modulating waveforms applied to the MOD IN AM AC/DC jack (28).
F1 1 AMP DELAY fuseholder	Rear Panel	Houses line protective fuse.
115V/230V slide switch	Rear Panel	Permits Signal Generator to operate from either 115 volt or 230 volt power lines.
Power receptacle	Rear Panel	Polarized three-pin connector through which line power is coupled to the Signal Generator.

2-12. OPERATING PROCEDURES

2-13. UNMODULATED (CW) OPERATION. To obtain an unmodulated r-f output, proceed as directed below.

a. Release the 1 kHz, AM AC/DC, PULSE DC, FM DC and COUNT INPUT pushbutton switches; the CW indicator will illuminate.

b. Set the RANGE MHz to the band containing the desired frequency. If the desired operating frequency is between 61 kHz and 8.0 MHz, set the RANGE MHz switch to PLUG-IN and set the Model SG-1001 Frequency Extender module RANGE switch to the appropriate frequency band.

c. Set the VERNIER control to mid-range.

d. Rotate the FREQUENCY control until the desired output frequency is indicated on the frequency counter tubes. (For a more accurate setting of the output frequency, note the last digit of the counter display. Depress the DISPLAY RESOL X100 pushbutton switch and again observe the counter display; the last digit of the display previously noted is now the first. With the DISPLAY RESOL X100 pushbutton switch depressed, carefully adjust the FREQUENCY and/or VERNIER control until the exact output frequency is obtained. Release the DISPLAY RESOL X100 pushbutton switch.)

e. Set the dBm 50Ω switch and control to obtain the desired output level, as indicated on the RF LEVEL meter.

EXAMPLES

1. Desired output level is -47 dBm. Set the dBm 50Ω switch to -40 2.2 mV and adjust the dBm 50Ω control to obtain an RF LEVEL meter indication of -7 on the dB scale.

2. Desired output level is 200 V. Set the dBm 50Ω switch to -60 .22 mV and adjust the dBm 50Ω control to obtain an RF LEVEL meter indication of 2.0 on the lower VOLTS scale.

f. Couple the RF OUT jack to the load via a 50 ohm cable. Coupling the RF OUT jack to a mismatched load may not affect the RF LEVEL meter indication; the RF LEVEL meter will not, however, indicate the true voltage appearing across the load. To calculate the voltage across an impedance other than 50 ohms, consider the Signal Generator as an ideal voltage source of value 2E behind 50 ohms, where E is the output voltage indicated by the RF LEVEL meter. The voltage across the load is

$$V_L = 2E \frac{R_L}{R_L + 50}$$

2-14. INTERNAL (1 kHz) AM OPERATION. To obtain an r-f output amplitude-modulated by the internal 1 kHz audio oscillator, proceed as directed in the following steps. (refer to paragraph 2-28 to calibrate the frequency of the internal 1 kHz oscillator.)

a. Rotate the AM LEVEL control fully counterclockwise and then depress the AM AC/DC pushbutton switch. Ascertain that the 1 kHz, PULSE DC, FM DC and COUNT INPUT pushbutton switches are released.

b. Perform steps b through e of paragraph 2-13.

Note

The maximum r-f carrier frequency level during internal or external AM operation is limited to +14 dBm. (At 100% modulation, the peak envelope power reaches +20 dBm.)

c. Depress both the 1 kHz and AM AC/DC pushbutton switches and adjust the AM LEVEL control to obtain the desired percentage amplitude modulation, as indicated on the % AM meter. Modulation percentages up to 100% can be obtained.

Note

When the 1 kHz pushbutton switch is depressed, an auxiliary 1 kHz output (1.5 volts peak-to-peak, 1000 ohms source impedance) is available at the MOD OUT jack for application to auxiliary test equipment.

d. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-15. EXTERNAL AM OPERATION. To obtain an r-f output amplitude-modulated by an externally generated waveform, proceed as directed in either paragraph 2-16 or 2-17.

2-16. A-C Coupling.

a. Depress both the AM AC/DC and AC pushbutton switches. Ascertain that the 1 kHz, PULSE DC, FM DC and COUNT INPUT pushbutton switches are released.

b. Perform steps b through e of paragraph 2-13.

CAUTION

DO NOT EXCEED MODULATING INPUT VOLTAGES OF 10 VOLTS PEAK-TO-PEAK.

c. Couple the externally generated modulating waveform to the MOD IN AM AC/DC jack.

Note

A sinusoidal modulating waveform of typically 2 volts rms (into 600 ohms) is required for 100% AM.

The maximum usable percentage modulation (second-order harmonic sideband typically 20 dB below modulation frequency sideband level) as a function of modulating frequency is illustrated in table 1-1.

d. Adjust the AM LEVEL control to obtain the desired percentage modulation as indicated on the % AM meter.

e. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-17. D-c Coupling. The d-c coupled external AM mode of operation is required when the modulating waveform has frequency components below 20 Hz. It is also useful for remote analog control of the output by means of a positive or negative dc level applied either by itself or simultaneously with a modulating waveform for analog control of the output level. To operate in this mode, perform steps a through e of paragraph 2-16 and then continue as follows.

a. Depress the DC pushbutton switch. Note the RF LEVEL meter indication; if it is unchanged from that set during calibration, the dc component of the applied signal is 0 volts. If it is less, the applied signal has a negative dc component.

Note

The rms level of the output signal can be reduced by increasing the negative d-c component of the applied modulating waveform. A nominally −4 volt dc component is required to cut off the output when the AM LEVEL control is set fully clockwise. Conversely, a positive d-c voltage will increase the output level by up to 6 dB or more (up to the maximum output available from the power amplifier).

The % AM meter indication is meaningless when the dc component of the applied modulating waveform is other than 0 volts.

b. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-18. EXTERNAL PULSE OPERATION. To obtain an r-f output pulse-modulated by an externally generated waveform, proceed as directed in steps a through e of paragraph 2-13 and then continue as follows.

Note

The external pulse modulation capability is not operative when the RANGE MHz switch is set to PLUG-IN (carrier frequencies from 61 kHz to 8.0 MHz).

a. Depress both the PULSE DC and PULSE pushbutton switches; the CW indicator will no longer be illuminated and the RF LEVEL meter will indicate an arbitrary value until a pulse input is coupled to the PULSE DC jack. The r-f output level at the RF OUT jack will be typically below that preset by

performing steps a through e of paragraph 2-13 by the on/off ratio illustrated in table 1-1.

CAUTION

DO NOT EXCEED MODULATING INPUT VOLTAGES OF 10 VOLTS PEAK.

b. Couple the modulating waveform to the MOD IN PULSE DC jack.

Note

The modulating signal source must be capable of providing a waveform in excess of +1 volt (into 50 ohms), the threshold voltage required for a leveled r-f output of selected amplitude. The pulse "on" condition is guaranteed for input levels above +1.0 volts and the "off" condition applies when the input level is less than +0.3 volts. Pulse rise and fall times must be less than 5 usec for proper leveling operation.

c. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-19. EXTERNAL VIDEO OPERATION. To obtain an r-f output video-modulated by an externally generated waveform, proceed as directed in steps a through d of paragraph 2-13 and then continue as follows.

Note

The external video modulation capability is not operative when the RANGE MHz switch is set to PLUG-IN (carrier frequencies from 61 kHz to 8.0 MHz).

a. Set the dBm 50 Ω switch and control to obtain the maximum desired video output level (limiting threshold), as indicated on the RF LEVEL meter. (See examples following paragraph 2-13.e.)

b. Depress both the PULSE DC and VID pushbutton switches; the CW indicator will no longer be illuminated and the RF LEVEL meter will indicate an arbitrary value until a video input is coupled to the MOD IN PULSE DC jack. The r-f output level at the RF OUT jack will be typically below that preset by performing steps a through d of paragraph 2-13 and above by the on/off ratio illustrated in table 1-1.

CAUTION

DO NOT EXCEED MODULATING INPUT VOLTAGES OF ±10 VOLTS.

c. Couple the modulating waveform to the MOD IN PULSE DC jack.

Note

Minimum video modulation input level of +1 volt is required for activation of the leveling circuitry.

The carrier level of the double-sideband output signal is proportional to the positive dc component of the modulating waveform. Maximum carrier suppression occurs at 0 volts dc.

d. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-20. INTERNAL (1 kHz) FM OPERATION. To obtain an r-f output frequency-modulated by the internal 1 kHz audio oscillator, proceed as directed in the following steps. (Refer to paragraph 2-28 to calibrate the frequency of the internal 1 kHz audio oscillator.)

a. Depress the FM DC pushbutton switch; ascertain that the 1 kHz, AM AC/DC, PULSE DC and COUNT INPUT pushbutton switches are released.

b. Perform steps b through e of paragraph 2-13.

c. Rotate the FM SENS control fully counterclockwise.

d. Depress the 1 VDC FM CAL pushbutton switch and, while holding this switch depressed, carefully adjust the FM SENS control (alternately depressing and releasing the DISPLAY RESOL X100 pushbutton switch, if necessary) until the alternate frequency counter reading indicates a frequency shift equal to the desired peak deviation. Release both the 1 VDC FM CAL and DISPLAY RESOL X100 pushbutton switches.

Note

Linear operation is obtained at peak deviations of ±0.1% or less.

To obtain very low peak deviations (to ±0.01% or ±0.001%), adjust the FM SENS control (step d) until the frequency shift is 10 or 100 times greater than the desired peak deviation. After step d is completed, depress either the ATTEN FM DEV X0.1 or X0.01 pushbutton switch.

e. Depress the 1 kHz pushbutton switch.

f. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-21. EXTERNAL FM OPERATION. To obtain an r-f output frequency-modulated by an externally generated waveform, proceed as directed in the following steps.

a. Depress the FM DC pushbutton switch; ascertain that the 1 kHz, AM AC/DC, PULSE DC and COUNT INPUT pushbutton switches are released.

b. Perform steps b through e of paragraph 2-13.

c. Rotate the FM SENS control fully counter-clockwise.

d. With knowledge of the peak-to-peak modulating voltage level and the desired peak-to-peak frequency deviation, divide the former into the latter to determine the required peak deviation sensitivity.

e. Depress the 1 VDC FM CAL pushbutton switch and, while holding this switch depressed, carefully adjust the FM SENS control (alternately depressing and releasing the DISPLAY RESOL X100 pushbutton switch, if necessary) until the frequency counter shift indicates the desired peak deviation sensitivity (numeric). Release both the 1 VDC FM CAL and DISPLAY RESOL X100 pushbutton switches.

Note

A positive input voltage will cause the frequency counter indication to increase with clockwise rotation of the FM SENS control while a negative input voltage will cause it to decrease.

f. Couple the source of modulation to the MOD IN FM DC jack.

Note

For symmetrical modulation about the selected center frequency, it is essential that no d-c component be present in the applied modulating signal. A 10 μf d-c blocking capacitor in the signal path will insure a flat frequency response down to 20 Hz while simultaneously preventing unintentional center frequency shift due to variations in d-c level.

For analog control of the center frequency (such as in phase lock systems), the d-c blocking capacitor must not be employed.

The input impedance of the MOD IN FM DC jack is nominally 5000 ohms.

g. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-22. CONCURRENT AM/FM OPERATION. To obtain an r-f output concurrently amplitude and frequency modulated by the internal 1 kHz audio oscillator, proceed as directed in paragraph 2-23. If external modulation sources are to be employed, proceed as directed in paragraph 2-24.

2-23. Internal 1 kHz Modulation. Refer to paragraph 2-28 to calibrate the frequency of the internal 1 kHz oscillator.

a. Perform step a of paragraph 2-20.

b. Perform steps b through e of paragraph 2-13.

c. Perform steps c, d and e of paragraph 2-20.

d. Depress the AM AC/DC pushbutton switch and adjust the AM LEVEL control to obtain the desired percentage modulation, as indicated on the % AM meter.

e. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-24. External Modulation.

a. Perform step a of paragraph 2-21.

b. Perform steps b through e of paragraph 2-13.

c. Perform steps c through f of paragraph 2-21.

d. Depress both the AM AC/DC and AC pushbutton switches and perform steps c and d of paragraph 2-16.

e. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-25. CONCURRENT FM/PULSE MODULATED OPERATION. To obtain an r-f output concurrently frequency and pulse modulated by external sources, proceed as follows.

a. Perform step a of paragraph 2-21.

b. Perform steps b through e of paragraph 2-13.

c. Perform steps c through f of paragraph 2-21.

d. Depress both the PULSE DC and PULSE pushbutton switches and perform step b of paragraph 2-18.

e. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-26. CONCURRENT FM/VIDEO MODULATED OPERATION.

a. Perform step a of paragraph 2-21.

b. Perform steps b through e of paragraph 2-13.

c. Perform steps c through f of paragraph 2-21.

d. Depress both the PULSE DC and VID pushbutton switches and then perform step c of paragraph 2-19.

e. Couple the Signal Generator to the load as directed in paragraph 2-13.f.

2-27. FREQUENCY COUNTER OPERATION. The digital frequency counter that indicates the operating frequency of the Signal Generator doubles as a counter for externally generated waveforms. To operate

the Signal Generator as a frequency counter, proceed as directed in the following steps.

a. Depress the COUNT INPUT pushbutton switch.

b. Couple the signal to be counted to the SIG IN jack. The indicator tubes will display the applied signal frequency in kHz. To resolve the frequency of the applied signal down to 10 Hz, depress the DISPLAY RESOL X100 pushbutton switch.

Note

The maximum frequency that can be read directly by the counter is 1, 999. 99 kHz.

Energization of the external count circuitry does not disable the r-f output of the Signal Generator.

2-28. CALIBRATING INTERNAL 1 kHz AUDIO OSCILLATOR FREQUENCY. To set the internal audio oscillator to a desired frequency within its adjustable range from 800 to 1200 Hz, proceed as follows:

a. Depress both the COUNT INPUT and the DISPLAY RESOL X100 pushbutton switches.

b. Depress the 1 kHz pushbutton switch and couple the MOD OUT jack to the SIG IN jack.

c. Adjust the INT MOD AM/FM screwdriver control to obtain the desired oscillator output frequency.

d. Release the 1 kHz, COUNT INPUT and DISPLAY RESOL X100 pushbutton switches.

2-29. PACKAGING.

2-30. Figure 2-3 illustrates the method of packing the Signal Generator for long term storage or shipment. For short term storage, use a suitable protective covering (such as a sheet of paper or plastic) and store the instrument in a clean and dry area. Store accessories and this instruction manual in a carton or bag and fasten to the equipment to avoid loss.

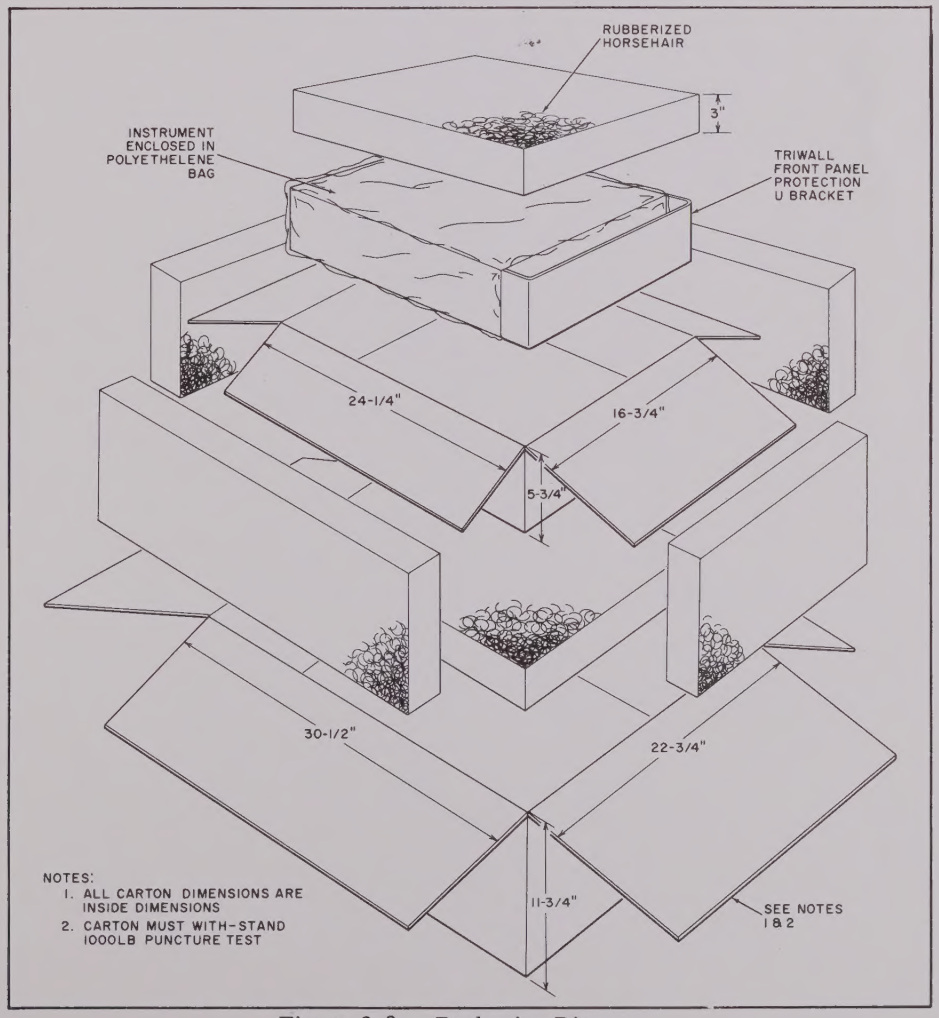


Figure 2-3. Packaging Diagram

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